A. Overview Information

I. Federal Agency Name: Defense Advanced Research Projects Agency, Information Processing Technology Office (DARPA/IPTO)

II. Title: Efficient Compilation and Code Development (ECCD)

III. Announcement Type: Request for Information (RFI)

IV. Solicitation Number: RFI 08-03

V. CFDA Number: 12.910

VI. Key Dates

a. Position Papers Due: 4:00 PM (ET), October 31, 2007

b. Workshop Registration Deadline: 4:00 PM (ET), November 2, 2007

c. Workshop Registration Acceptance Notifications sent out: November 7, 2007

d. Invitations to Present at the Workshop sent out: November 7, 2007

e. Workshop Presentations Due: 8:00 AM (ET), November 14, 2007

f. Workshop: November 27, 2007

B. Full text of announcement

I. Description

Today's computing systems are increasingly becoming a complex combination of processing elements, from the chip to the board and system level. The development of optimized high-performance applications codes for these systems is a formidable effort. One of the issues that has a significant impact on developer productivity is the escalating architectural and performance optimization expertise required by the user. Realizing the full performance potential of each computing system - from chip level to a full system - is becoming increasingly labor and cost intensive. Often, an architecture-specific processing system representation and code development environment must be developed for each application, which prevents code portability and hinders upgrades as they become available. Current production-quality compilers are typically optimized for specific chips or COTS systems. This approach is becoming a major problem for DoD applications – it either prevents users from achieving the full processing potential of the system, or requires extensive expertise, effort, development time, and cost to obtain optimized performance from computing resources. As DoD applications and computing systems increase in complexity, these issues will increasingly limit the processing efficiency and performance available to the warfighter.

In accordance with FAR 35.007(j), the Information Processing Technology Office (IPTO), Defense Advanced Research Projects Agency (DARPA) requests information on identifying and evaluating concepts for a compiler environment that will dramatically reduce the time and effort required to effectively characterize a broad spectrum of complex processing systems and enable the compilation of diverse applications in order to minimize the execution time of the executable code. The requested information is sought to identify the key technologies, concepts and components required to achieve the envisioned goals and promote productive interactions among

the various relevant communities that must be combined to create the desired results. A Broad Agency Announcement and/or other solicitation may be posted at a later date, but the Government is not obligated to do so, and this RFI does not signify any firm intention by the Government to do so.

DARPA seeks information concerning compiler environments that provide efficient utilization of computing resources, without requiring the application developer to have prior detailed knowledge of the target computing system or the compiler itself. Approaches must be applicable across a broad range of processing architectures. These architectures may consist of either a single multi-core processor or very large multi-processor systems. Memory may be either shared or distributed, and processors may be homogenous or heterogeneous. Application software will range across several DOD domains.

A high-level representation of the proposed environment is shown in Figure 1. This figure illustrates an approach that would develop a possible separate "System Characterization Program," take the System Model and execute on the targeted platform. The characterization program would produce a data file containing compiler-specific information needed to deal with any target processing system comprised of elements represented by base system components and capabilities. This characterization data, together with the System Model, would drive the Compiler Environment (Figure 1).

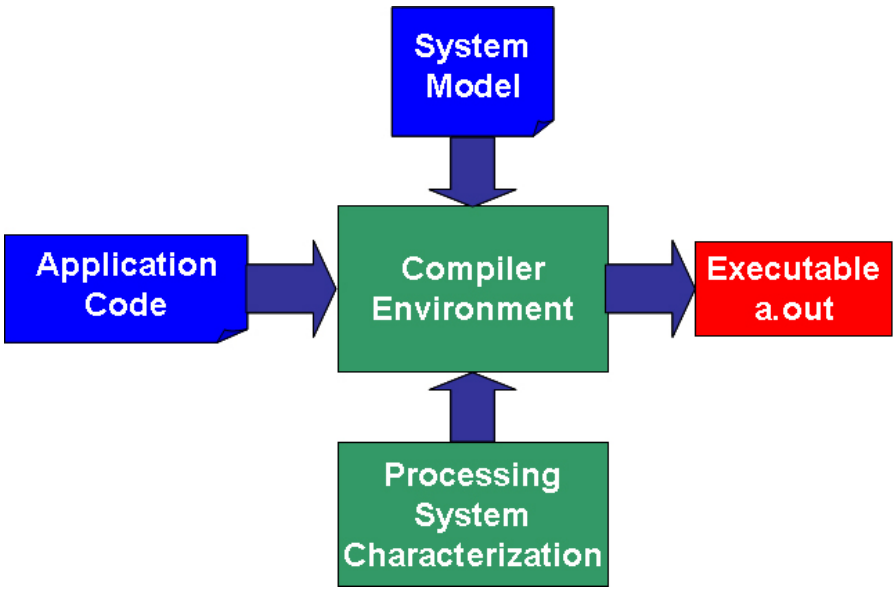

Figure 1

DARPA/IPTO is soliciting position papers on all of the following topics:

- Processing system characterization of large scale parallel computers;
- Compiler development, and overall application development environment issues;
- The ability to develop accurate and complete characterization of complex processing systems;
- Self-assembling or re-targeted compiler approaches;

- System models and compiler optimizations for large scale parallel computers;
- High level application development environments;
- Potential languages for large-scale parallel computers.

The position paper should provide answers to the following questions:

1. What characteristics of a computational system are required to sufficiently represent a computer's capabilities and could be used by a self-assembling or re-targetable compiler environment?
2. What are the causes of the performance gaps between what current compilers can provide and what computational systems should be able to achieve?
3. What compiler approaches are possible to enable a compiler system or environment that would be self-assembling and optimize capabilities to efficiently address a broad range of computational systems?
4. What are the characteristics of a compiler environment that will significantly improve development productivity and minimize execution time for large-scale parallel computers?
5. What is the structure of the ideal, self-assembling or re-targetable compiler environment that will efficiently recognize the computational capabilities and utilize the optimal compiler algorithms for a large-scale parallel computer?
6. Which (preferably existing) computer language will enable a compiler environment to generate executables for applications codes with minimum execution time when executed on a large-scale parallel computer system?
7. What development feedback or closed loop capability is needed for a computational system, compiler, and application environment?
8. What is the collective expertise required for the optimal team capable of developing a high quality self-assembling or re-targetable compiler environment for large-scale parallel computers that can satisfy the development and performance requirements for DoD application code developers?

Interested parties should submit their position paper AND a curriculum vita of the principal or lead person representing the submittal by responding to this RFI as described in Section IV - Application and Submission Information below. DARPA will acknowledge receipt of the submission, but will not provide feedback. However, DARPA/IPTO might invite selected individuals to present talks as part of a workshop and provide further discussion on relevant topics, based on their submissions. **Submissions must not contain any proprietary information**. All information submitted in response to this announcement will be considered public information and will be made available to workshop attendees and, in the event of an associated solicitation, will be considered available to be placed on a public web site.

All information contained in the RFI is preliminary, as well as subject to modification, and is in no way binding on the Government. This RFI incorporates by reference FAR 52.215-3, "Request for Information or Solicitation for Planning Purposes (OCT 1997)," with the same force and effect as if it were given in full text [reference paragraph (c) of this provision, the "purpose" of this RFI is detailed in this announcement].

WORKSHOP

A workshop will be held for RFI respondents on November 27, 2007, which will include invited presentations, discussions, and Q&A. **In order to attend the workshop, attendees must submit an RFI response by October 31, 2007 and be registered on the registration site by November 2, 2007.** Registration information will be sent out upon receipt of your position paper. Acceptance of registration will be conditional upon receipt of a responsive position paper as well as space limitations. Notification of registration acceptance will be sent via email on November 7, 2007. Due to space limitations, participation may be restricted to a single representative of an institution or a single co-author of a given position paper. In addition, total attendance may be limited by space availability. Registration acceptance will be on a "first come, first served" basis, i.e., based on order of receipt of *responsive* position papers. When the maximum number of attendees has been reached, registration will be closed and no further attendees will be accepted. Non-U.S. citizens may attend pending the completion of the Foreign National Information Request Form found on the registration site. Attendance at the workshop is voluntary. Attendance is not required to propose to subsequent Broad Agency Announcements or research solicitations on this topic. There is no fee for attending the workshop. DARPA will not provide cost reimbursement for workshop attendance or any costs associated with response to this announcement.

Workshop participants may be invited to brief their RFI responses. Due to limited time, presenters may be selected based upon details of their RFI responses. In addition, time limits on each presentation will be determined based on a variety of factors, including the number of presenters and the need to reserve time for other presentations and discussions. Invitations to present a briefing at the workshop will be sent via email on November 7, 2007. **Presentations must not contain any proprietary data.** In particular, all presentations submitted as a supplement to the RFI will be considered public information and will be made available to workshop attendees and, in the event of a BAA or other solicitation, on a public web site as well.

All materials presented at the ECCD RFI Workshop must be approved in advance by both the organization that funded the research and the DARPA Program Manager. The DARPA Program Manager will screen the material for sensitive, but unclassified material. For this reason, any material you wish to present at the workshop must be received no later than November 14, 2007. It is the presenters' responsibility to ensure the material has been approved for public release by the organization that funded the research.

Workshop Point of Contact: All questions regarding the workshop should be sent to ECCDWorkshop@darpa.mil.

II. Award Information

This notice, which constitutes the complete RFI package, is not a Request for Proposals (RFP), and is not to be construed as a commitment by the Government to issue a solicitation or ultimately award a contract. Responses will not be considered as proposals nor will any award be made as a result of this synopsis. The Government is not interested in specific company capability information and will not entertain such submissions. Any costs incurred as a result of responding to this announcement shall be borne by the respondent and cannot be charged to the Government for reimbursement.

III. Eligibility Information

1. Eligible Applicants

All responsible sources capable of satisfying the Government's needs may submit a position paper that shall be considered by DARPA. Non-U.S. citizens may attend the workshop pending the completion of the Foreign National Information Request Form found on the registration site. Attendance at the workshop is voluntary. Attendance is not required to propose to subsequent Broad Agency Announcements or research solicitations on this topic.

2. Cost Sharing or Matching – N/A

IV. Application and Submission Information

1. Addresses to Request Application Package

This announcement contains all information required to submit a position paper. No additional forms, kits, or other materials are needed.

2. Content and Form of Application Submission

DARPA/IPTO requires completion of an online RFI Cover Sheet for each response, by accessing the URL below:

www.csc-ballston.com/rfi/rfiindex.asp?RFIid=08-03

After finalizing the Cover Sheet Submission, the offeror must submit the Confirmation Sheet that will automatically appear on the web page. The Confirmation Sheet should be the first page of your response. Failure to comply with these submission procedures may result in the position paper not being considered, and/or the submitter not being permitted to brief at the workshop.

Submissions must be sent via email to ECCDWorkshop@darpa.mil. DARPA will acknowledge receipt of submissions via return email.

Position papers are limited to 10 pages in length (not including cover sheet), and respondents are encouraged to be as succinct as possible while at the same time providing actionable insight. Each response should address the questions posed above and should comprise the following sections:

Section I. Cover Page (see Confirmation Sheet above) to include the following information:

- Respondent Name
- Organization
- Mailing address
- Phone number
- Fax number
- Email address

Section II. Details of submitted position on research in the area of self-assembling or re-targetable compiler environments, preferably organized in a question/answer format, addressing the above questions and any others the submitter deems important. Within the 10 page submission limit shall be included a one page executive summary that provides a concise overview of the position paper and its primary points.

Section III. Additional Information: In addition to the required submission, respondents may attach a one page list of key citations (including URLs if available).

3. Submission Dates and Times

Submissions will be considered if they are received by 4:00 PM (ET), October 31, 2007.

4. Intergovernmental Review – N/A

5. Funding Restrictions - N/A

6. Other Submission Requirements – N/A

V. Application Review Information

1. Criteria – N/A

2. Review Process – N/A

VI. Award Information Administration – N/A

1. Award Notices – N/A

2. Administrative and National Policy Requirements – N/A

3. Reporting – N/A

VII. Agency Contacts

All administrative correspondence and questions concerning this announcement should be directed to one of the following administrative addresses:

Fax: 703-741-7804, Addressed to: DARPA/IPTO, Attn: RFI 08-03

Electronic Mail: ECCDWorkshop@darpa.mil

Electronic File Retrieval: http://www.darpa.mil/ipto/Solicitations/solicitations.htm